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ABSTRACT

This instructional unit is one of 10 developed by students on various energy-related areas that deals specifically with insulation. Its objective is for the student to be able to determine insulation needs of new or existing structures, select type to use, use installation techniques, calculate costs, and apply safety factors. Some topics covered are basics of heat energy, insulating effectiveness, types of insulation materials, areas of building most frequently insulated, estimating insulation amounts, and selecting a reliable insulating contractor. Material in each unit may include some or all of the following: terminal and specific objectives, list of references, information sheet with terms and definitions, informative materials, transparency masters, assignment sheet(s), and unit test with answers. (YLB)

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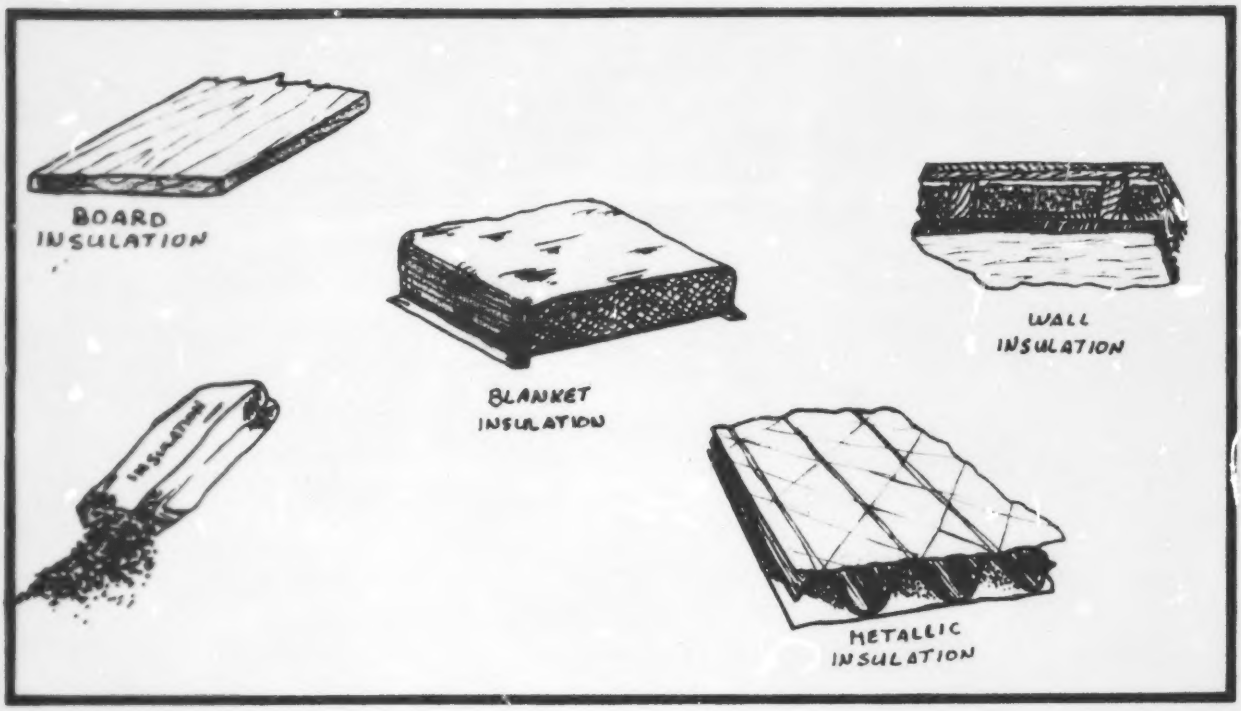
# INSULATION




by

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# INSULATION

## TERMINAL OBJECTIVE

Upon completion of this unit the student will be able to determine the insulation needs of new or existing structures, select kind to use, utilize installation techniques, calculate costs and apply safety factors. This will be evidenced by completing assignment sheets and exhibiting a recommended 85% accuracy on the unit test.

## SPECIFIC OBJECTIVES

Upon completion of this unit the student will be able to:

1. Select factual general information concerning insulation from non-factual information.

2. Match insulation terminology to a given set of definitions.

3. List four factors in written form that make installation of insulation a wise decision by the consumer.

4. Identify in written form at least five of the areas of a structure most frequently insulated.

5. Identify in written form at least three safety precautions the individual should take when applying insulation.

6. Describe how a consumer can determine reliability of a contractor to install insulation including at least four different factors to look for.

7. Select five personal safety factors to observe when installing insulation from a given list of possibilities.

## WHAT IS INSULATION?

Insulation is any material used to slow the transfer of heat from one area to another. Fibrous materials which are light and very porous are highly effective in slowing heat transfer.

Insulation for buildings has a long history. Some early forms included sawdust, cork, animal hair and vegetable fibers. The first man made insulations were made in Wales, England in 1840. Production of an insulation made from slag that remained from the manufacture of iron used for Civil War guns, called mineral wool, first began in the United States in 1875.

"Mineral Wool" is a generic term that applies to all inorganic fibrous insulations such as slag wool, rock wool and fiber glass.

Insulation products did not change appreciably until the 1920's, when batts and blanket (will be discussed later) insulations, as well as methods using air pressure to place loose insulations were developed. Fiber glass insulation was developed in 1934.

Although man made insulations have been produced for over a century, it has only been over the past twenty years that the public has shown great interest in the subject. Today the American people are looking for ways to save energy and to trim fuel costs.

The purpose of this unit is to provide the reader with a basic knowledge of:

1. The basics of heat energy
2. Insulating effectiveness
3. How to determine the insulating needs of a home
4. The types of insulation materials
5. The areas of a building most frequently insulated
6. How to estimate insulation amounts
7. How to install various types of insulations
8. Some correct and incorrect techniques in the installation of insulation
9. Some personal precautions and safety measures
10. How to select a reliable insulating contractor

## THE BASICS OF HEAT

Some basic knowledge of heat energy is necessary to understand the best use of insulation and energy conservation. Heat is useful to us when it can be produced economically, measured exactly, and applied at a specific place for a specific purpose.

To best understand heat energy, think of heat flowing down a descending temperature hill just as water flows down hill. Higher temperatures always flow to lower temperatures. The greater the temperature difference between two bodies, the greater the amount of heat flow. The movement of heat energy is called transfer.

Heat can be transferred by three methods: 1. conduction, 2. convection, and 3. radiation.

The primary method of heat transfer in solids is by conduction. Place the end of an iron rod over a candle flame; soon the rod begins to warm at the point where the flame meets the rod. In time the heat will be conducted to the other end of the rod. The motion of the heat cannot be seen unless very high temperatures are reached. In this case the rod will slowly turn red at the heated end. As the heat is continuously applied, the red glow will advance and you can see the movement of heat by conduction.

A scientific explanation of the conduction of heat through solid objects is that the molecules of the object are set into violent motion as the object is heated. These molecules collide with their neighbors, thus passing the energy on to them. The molecules themselves do not move along the object; they merely pass the energy along.

Transfer of heat by convection means that the heat is transferred

by the motion of the medium. For example: Warm air rising through the ducts and registers in a home warms the building. Again, the example of the rod heated by the candle. The rod is heated by conduction; as the rod is heated it warms the air. The movement of the air may in turn warm another object; therefore, convection is the movement of heat energy by the movement of the medium. Air and water are usually the mediums associated with convection.

The third form of heat transfer is radiation. Although, the least understood, radiation is the most important method of heat transfer. Heat energy from the sun reaches us by radiation. As one steps from the shade into direct sunlight, the radiant heat of the sun is felt almost immediately. The warmth of a fireplace is another example.

There are several theories about radiant heat; however, they will not be discussed as they are beyond the scope of this unit. In brief, radiant energy is in the form of waves very much like light waves. All bodies radiate or absorb radiant energy. Remember heat always flows from a higher to a lower temperature.

Heat is measured in terms of the British thermal unit (BTU). A BTU is defined as the amount of heat energy required to raise the temperature of one pound of water one degree Fahrenheit. A BTU may be thought of as the amount of heat that a kitchen match gives off as it burns from end to end.

## INSULATING EFFECTIVENESS

The resistance of a building material to the transfer of heat is called the "Resistance value" or "R-value". The higher the R-value the more effective the insulation is against winter heat

loss and summer heat gain. R-value ratings makes it possible to add a thermal value to a whole series of materials.

The key to insulation effectiveness is in the R-value ratings. It is not the thickness of the material. An R-value table for a variety of materials is listed in Figure 1.

When purchasing insulating materials, be sure that the R-value rating is placed on the packaging. Remember, it is not the thickness that tells you how well a material insulates, it is the R-value rating.

A second measure of insulating effectiveness is known as the U-value. Mathematically, it is defined as the number of BTU's that will pass through 1 square foot of the building section in 1 hour for each degree Fahrenheit of temperature difference between the inside and outside surfaces of the section.

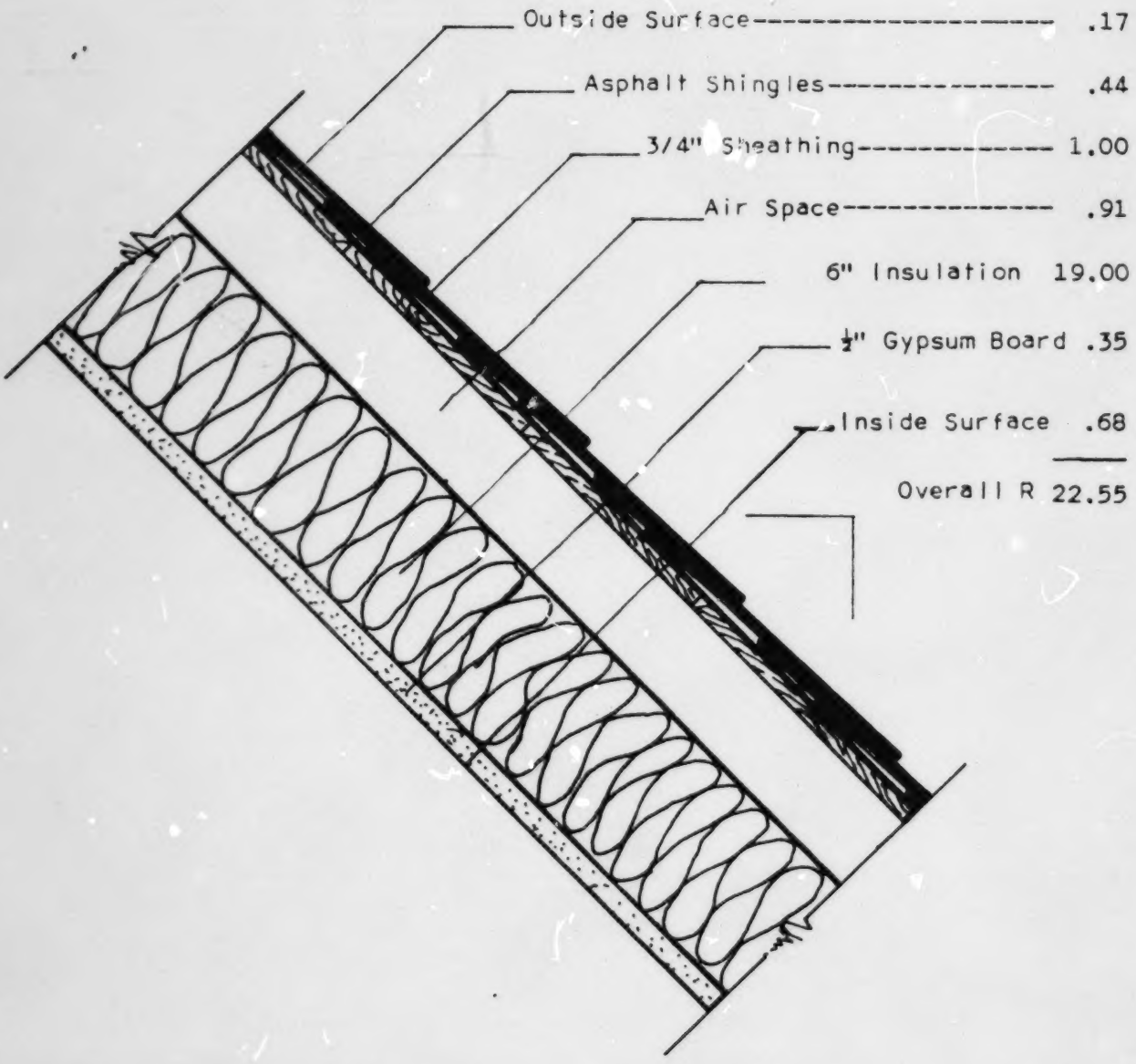
To determine the U-value, add all the R-values in the building section and divide the sum into 1. Example: Figure 2 illustrates a sample roof section. The overall R-value is 22.55. The U-value is 1 ÷ 22.55 which is .045. The U-value is the reciprocal of all the R-values for the building section. The lower the U-value, the higher the overall insulating value.

FIGURE 1

Resistance Values of Common
Building Materials and Air Spaces

| Material | R-Value |
|---|---|
| Air Spaces 3/4" | |
| Non-reflective surface | .75 (summer) |
| Reflective, One Surface | .87 (winter) |
| Reflective, One Surface | 2.22 (summer) |
| | 2.21 (winter) |
| Asphalt Roof Shingles | .94 |
| Brick, Common, Per Inch | .20 |
| Brick, Face, Per Inch | .11 |
| Carpet and Fibrous Pad | 2.08 |
| Carpet and Foam & Rubber Pad | 1.23 |
| Concrete Blocks, 3 oval cores | |
| Cinder Aggregate 4" thick | 1.11 |
| Cinder Aggregate 8" thick | 1.72 |
| Cinder Aggregate 12" thick | 1.89 |
| Sand and Gravel, 8" thick | 1.11 |
| Glass | |
| Single glass, winter | 1.10 |
| Single glass, summer | 1.04 |
| Insulating glass with | |
| 3/16" air space, winter | .62 |
| 3/16" air space, summer | .65 |
| 1/4" air space, winter | .58 |
| 1/4" air space, summer | .61 |
| 1/2" air space, winter | .49 |
| 1/2" air space, summer | .56 |
| Storm Windows | |
| 1 to 4" space , winter | .50 |
| 1 to 4" space, summer | .50 |
| Triple Glass | |
| Winter | .31 to .39 |
| Summer | .39 to .44 |
| Plywood | |
| 1/4" | .31 |
| 1/2" | .62 |
| 5/8" Particle Board | .82 |
| Softwood, per inch | 1.25 |
| Softwood Board 3/4" thick | .94 |

Figure 2


Outside Surface .17
Asphalt Shingles .44
3/4" Sheathing 1.00
Air Space .91
6" Insulation 19.00
½" Gypsum Board .35
Inside Surface .68
Overall R 22.55

HOW TO DETERMINE THE INSULATING NEEDS OF A HOME

Different areas of a house require different R-values of insulation. The attic needs a high R-value because a lot of heat is lost through the ceilings and attics. Walls and floors do not require as high an R-value rating. The map in Figure 3 identifies the R-value ratings for attics, walls, and floors for various parts of the United States.

The Better Business Bureau suggests you look at these facts:

1. Our homes use an estimated 25% of all energy consumed in our country today-about one and a half times as much as all our cars combined.

2. More than half of our homes energy bill is from heating and cooling alone.

3. Insulation materials prevent heat loss or gain considerably better than concrete, brick or wood.

4. Weatherstripping alone can reduce fuel costs significantly, and storm windows alone can save even more.

5. Attic insulation generally can save an average of 20% on winter fuel bills, and probably even more in the summer.

6. Insulated homes have a higher resale value than similar uninsulated homes.

There are a few items that should be checked in determining the insulation needs of a home:

1. The attic. As much as 45% of the heat loss occurs through the ceiling and roof.

   A. Check attic.

      ___ Is there any insulation?
      ___ Measure the thickness of any existing. If you do not know its R-value and it is less than 6 inches, additional insulation may be needed.
      ___ Ventilation. The circulation of air is very important. There should be at least one square foot of venting for every 150 square feet of attic floor space.

2. The walls. As much as 24% of heat loss occurs through the walls.

   A. Check walls.

   ___ In cold weather place your hand at several places on an interior wall and compare its temperature with that of an exterior wall. Adequately insulated exterior wall will feel only slightly cooler.
   ___ Feel for drafts around cabinets or outside walls, electrical plates, baseboards, doors and windows.
   ___ Inspect existing caulking for cracks.
   ___ Inspect weatherstrippings around doors and windows.

   Note: As much as 11% of heat loss occurs through windows and doors. This heat loss occurs by infiltration. Cooler air penetrating the warm interior causing heat loss by convection. In the summer the opposite occurs. Some infiltration is unavoidable; however, infiltration must be kept to a minimum.

3. The floors. As much as 20% of heat loss occurs through the floors.

   A. Check floors.

   ___ Cracks around foundation, baseboards, floor fixtures such as heat registers, etc.

4. Heating duct insulation. Insulating heat ducts will improve the delivery of heat; thus reducing fuel costs.

If inspection indicates a need for the installation of insulation, a few things need to be considered:

1. The climate conditions of the area. (See Figure 3)
2. The recommended R-values for attics, walls and floors for the area.
3. Where the insulation is to be installed.
4. The type of insulation to be installed.
5. The costs of materials and installation.

# RECOMMENDED R-VALUE STANDARDS

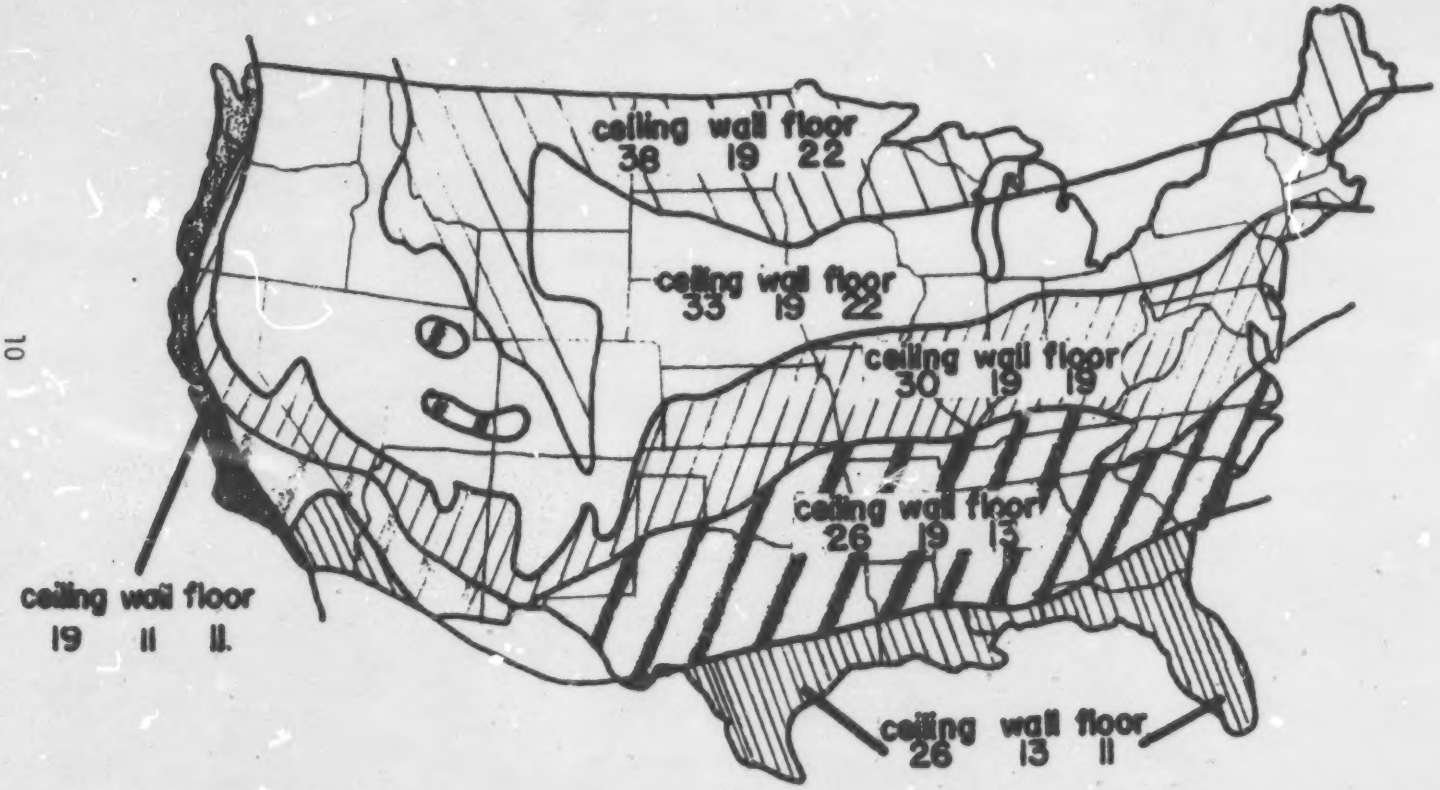



Figure 3

THE RECOMMENDED INSULATION STANDARDS FOR CEILINGS, WALLS AND FLOORS SHOWN ON THIS MAP WERE DEVELOPED FROM A COMPREHENSIVE COMPUTER ANALYSIS OF 71 U.S. CITIES. THESE RECOMMENDATIONS REPRESENT THE MINIMUM INSULATION LEVELS FOR HOMES IN YOU AREA, USING MATERIALS AND TECHNIQUES AVAILABLE TODAY. FIND YOUR LOCATION ON THE MAP AND YOU'LL FIND OUT HOW MUCH INSULATION YOU SHOULD USE.

## THE TYPES OF INSULATING MATERIALS

Insulation materials are available in many varieties; however, they are generally classified according to type:

1. Loose or fill insulation:

   glass fiber, rock wool, cellulosic fiber, vermiculite and perlite are best suited for non-standard joist spacing or when spaces between joists have many obstructions. Also, most commonly used to insulate buildings already constructed.

2. Batts:

   glass fiber, rock wool are best suited for standard joist, rafter and stud spacings of 16" or 24" and relatively free of obstructions. Normally used in unfinished attic floors, rafters and undersides of floors.

   Batt insulation is cut 15 or 23 inches wide, 1 to 7 inches thick and 4 or 8 feet long.

3. Blankets:

   glass fiber and rock wool best suited for standard rafter, joist and stud spacing of 16 and 24 inches and relatively free of obstructions.

   Blanket insulation is cut 15 or 23 inches wide, 1 to 7 inches thick. Rolls of blanket insulation are cut to length by the installer.

4. Foamed in place:

   organic components including urea and formaldehyde are contractor applied at the site. It is applied wet. Moisture is released during the drying process. An undesirable odorous gas is present as insulation cures.

5. Rigid board:

   extruded polystyrene bead board (expanded) polystyrene urethane board and glass fiber.

   Note: Rigid board polystyrene insulation must be covered with 1/2" gypsum wall board if used in a frame wall to insure fire safety.

   Rigid insulations have a high R-value for the relatively small thicknesses particularly urethane. Thickness varies from 3/4" to 4". Widths available in 24" and 48".

6. Metallic insulation:

shiny metallic surfaces of multi-spaced batts prevent heat loss by reflecting radiant heat.

These multi-spaced batts having 1, 2, 3 or more separate reflective air spaces have good insulating value but have the disadvantage because they are hard to use in small spaces and odd-shaped areas. If the air spaces are allowed to collapse the insulation becomes useless.

Metallic insulation is available to fit between 12, 16 and 24 inch stud of joist spacings.

7. Combinations:

Expanded mica and styrofoam is one of several types of insulation combinations. A combination of metallic reflective insulations and other types is very effective from the standpoint of both heating and condensation control.

The following table provides a brief description of several common insulation materials and the R-value rating according to thickness of application: Figure 4

| PRODUCT | R PER 1" THICKNESS |
|---|---|
| Loose Fill | |
| Mineral fiber (rock, slag or glass) | 2.20 - 3.00 |
| Cellulose | 3.70 |
| Perlite | 2.70 |
| Vermiculite | 2.13 |
| Flexible | |
| Mineral wool batts | 3.10 - 3.70 |
| Rigid | |
| Cellular glass | 2.63 |
| Expanded polystyrene (extruded) | 5.00 |
| Expanded polystyrene (molded) | 3.57 |
| Expanded polyurethane | 6.25 |
| Mineral fiberboard | 3.45 |
| Polyisocyanurate | 7.20 |
| Reflective | |
| Aluminum foil** | 3.48 |
| Foamed-In-Place | |
| Urea formaldehyde | 4.20 |
| Polyurethane | 6.25 |

*All values are for 75° F mean temperature.
**Thickness of foil not a factor; 3/4" air space on room side.

## HOW TO CHOOSE A GOOD INSULATING MATERIAL

Fire safety is very important. According to the National Bureau of Standards, many insulation materials are combustible and will release heat, smoke and gases when exposed to large continous fire sources. There are two fire saftey factors to consider: 1. The flammability of the material and 2. The area in which it is applied.

Insulations made from mineral products are naturally safe; vegetable products can be treated See manufacturer's recommendations and check flammability before installing any insulation.

Other factors to consider are: moisture resistance, rodent and insect resistance and R-value.

## AREAS OF A BUILDING MOST FREQUENTLY INSULATED

Information in this section will make reference to Figure 5.

## WHERE TO INSULATE A HOME

1. Exterior walls. Sections sometimes overlooked are the wall between living space and an unheated garage or storage room, dormer walls, and the portion of wall above the ceiling of an adjacent section of a split-level home. Pack insulation in narrow spaces between jambs and framing.

2. Ceilings with cold spaces above and dormer ceilings. An attic access panel can be insulated by stapling a piece of mineral wool blanket to its top.

3. Knee walls when attic space is finished as living quarters.

4. Between collar beams, leaving open space above for ventilation.

5. Around the perimeter of a slab on grade.

6. Floors above vented crawl spaces. When a crawl space is used as a plenum, insulation is applied to crawl space walls instead of the floor above.

7. Floors over an unheated or open space such as over a garage or a porch. The cantilevered portion of a floor.

8. Basement walls when below-grade space is finished for living purposes. Mineral fiber sill sealer between sill and foundation provides an effective wind infiltration barrier.

9. In back of band or header joists.

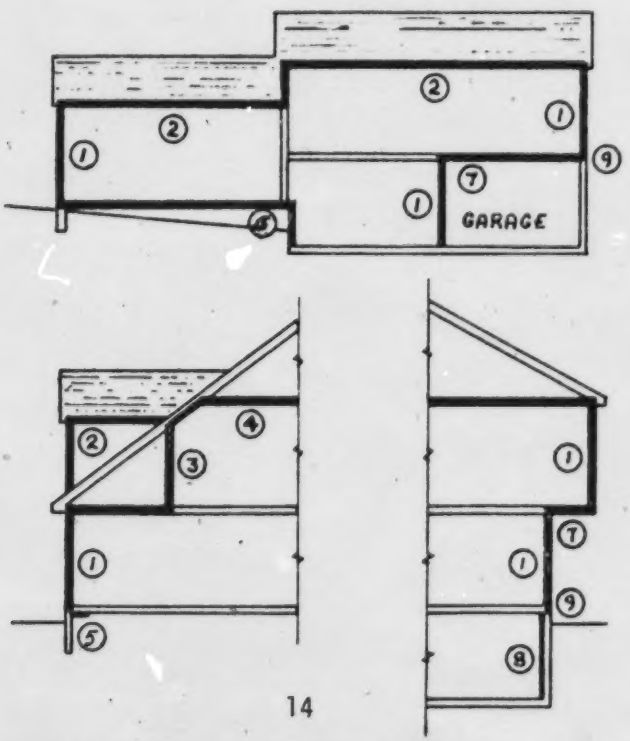



Figure 5

The Federal Housing Administration (FHA) requires that FHA insured mortgage must meet the Housing and Urban Development (HUD) "Minimum Property Standards". Among other things these standards require that the insulation type, manufacture and R-value at the labled thickness be in compliance with federal specifications. Additionally, persons doing the installation must execute a certificate giving the above data and date of installation.

Complete details about insulation requirements can be obtained from a local FHA office or by writing to U.S. Department of Housing and Urban Development, Washington, D.C., 20411. HUD/FHA does not "approve" any product. Anyone claiming a product is FHA approved is violating the law.

The Moisture Problem

Moisture or water vapor in the air is essential to the health and well being of human life. Factors which affect human comfort are the air temperature and the amount of water vapor in the air. Air which is too dry causes nasal passages irritations. Chapped lips and dry skin also result from air that lacks moisture. On the other hand too much water vapor makes a person feel dank and heavy and normal perspiration rate is slowed and certain respiratory difficulties may develop.

Water vapor is the most variable part of the atmosphere. The amount of water vapor in the air ranges from a mere trace to as much as .03 pounds of water in a pound of air. The air is said to be saturated with water vapor when it contains as much water as it can hold at that temperature.

Water vapor in the air is related to the temperature. The

higher the temperature, the greater the amount of water vapor can mix with air. Vapor also moves independently of the air, from areas of higher vapor concentration and higher temperatures to areas of lower temperatures.

Water vapor becomes a hazard to buildings when it condenses (changes from a vapor to a liquid) inside the structural cavity of a wall, floor or roof. Condensation occurs when air is cooled to the point that the water vapor can no longer remain in the air. This temperature is called the dew point. For example: If the air inside a building was at 72° Fahrenheit and the dew point was 38° Fahrenheit, water vapor in the air would remain until the temperature was lowered to 38°. At 38° the water vapor would change from vapor to liquid.

The dew point is related to air temperature and the amount of vapor in the air. Since warmer air can contain more vapor than cooler air it is more common to have higher dew point temperatures in the summertime.

Condensated water vapor can cause a multitude of problems within a structure. The effectiveness of insulating materials is reduced and high moisture content in building materials over a period of time will cause decay.

Moisture condensation in wall, floor and roof cavities can be controlled by 1. providing a vapor barrier on the interior side of a building to limit the entrance of vapor into the cavity and 2. ventilating spaces to dissipate vapor to the outside; however, more reliance is placed on the barrier. Air movement through the cavity is discouraged to minimize heat transfer.

Vapor barriers are available in a number of forms. Many batt and roll type insulation have a kraft paper or foil type vapor barrier applied to one side of the insulation. Other types include metal foils and films, polyurethane (plastic) sheets, asphalt impregnated kraft papers and felts, paints and other coatings. It is essential to form a continuous barrier on the inside of walls.

## HOW TO ESTIMATE INSULATION AMOUNTS

First measure the space to be insulated. Multiply the length and the width and subtract the areas of any doors, windows, etc. If the joists or studs are 16 inches apart multiply the product of the measured space by .90. If the joists or studs are 24 inches apart multiply by .94. The answer is the number of square feet of insulation. Example: A wall measures 8' x 30' with one window measuring 3' x 4' and a door measuring 3' x 7'. The studs are placed at 16" intervals.

Step 1. First find the area of the wall

30' length
x 8' width
240 square feet

Step 2. Find the areas of doors and windows.

| Window | Door |
|---|---|
| 4 | 7 |
| 3 | 3 |
| 12 square feet | 21 square feet |

Step 3. Add the areas of doors and windows and subtract from the area of the wall.

| | |
|---|---|
| 21 door | 240 area of wall |
| +12 window | - 33 area of door & window |
| 33 square feet | 207 square feet |

Step 4. Multiply the area .90. The factor used for joists and studs placed 16 inches apart.

207 area of wall
.90 factor of 16" centers of joists & studs
186.30 square feet

Step 5. Round off figure to nearest foot.

186 square feet - The amount of insulation needed.

An insulation dealer will tell you how many bags, rolls, batts, etc. of insulation needed to suit the R-value required and the square feet needed.

TOOLS NEEDED TO DO THE JOB RIGHT

1. A sharp knife to cut batts and blankets.
2. Straight edge to cut along. A short length of board works well.
3. Measuring tape or rule.
4. A rake, or other tool, to push or pull blankets and even out loose fill insulation.
5. Walk boards - Several boards at least 12 inches wide and 4 feet long of your insulating on attic.
6. A portable light.
7. Staple gun for applying wall insulation.
8. Hammer and prybar. If attic floor boards need to be removed and replaced.
9. Protective clothing. Some insulating materials can irritate the skin. A long sleeved shirt, long trousers, gloves, a cap, and when needed, goggles, safety glasses and face mask.

## HOW TO INSTALL INSULATION

The methods of installing insulation vary with the locations within the structure and the type of insulating materials used. It is not the purpose of this unit to present a step by step procedure but to indicate some important concepts about insulation and its installation. The following concepts are listed primarily as a guide. Application fundamentals are essentially the same and while they are not complicated, certain details are important.

1. Insulate all large and small spaces of the walls, floors, and ceilings.
2. Place insulation without compressing.
3. Install vapor barrier to the side that faces the interior of the building.
4. Apply insulation so that it fits snugly against framing members.
5. Repair rips or tears in the vapor barrier.
6. Be sure vapor barrier materials overlap so that a continuous barrier will be formed.
7. Staple through flange of vapor barrier to joists or studs every six to seven inches.
8. Measure length of batt or roll insulation and add an inch or two to the length.

Figure 6

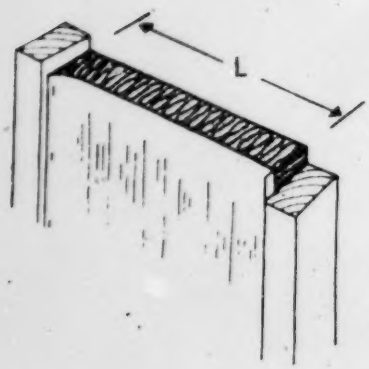
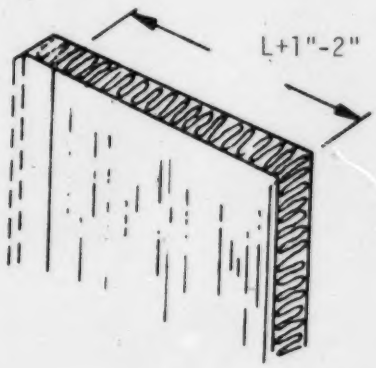
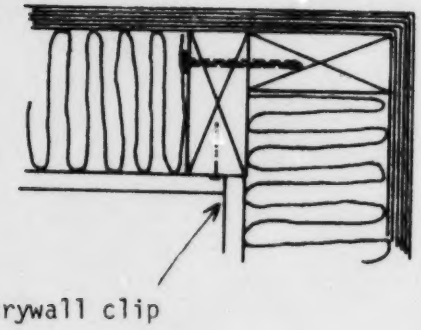



Figure 7

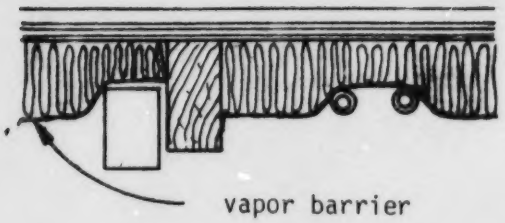


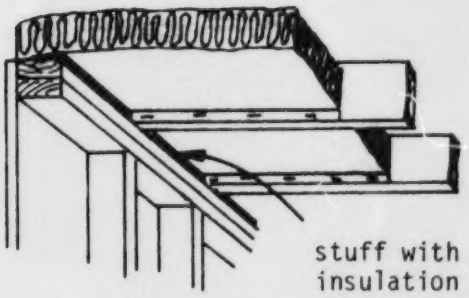
9. Use two stud corner posts and drywall clip to increase insulation in corners.



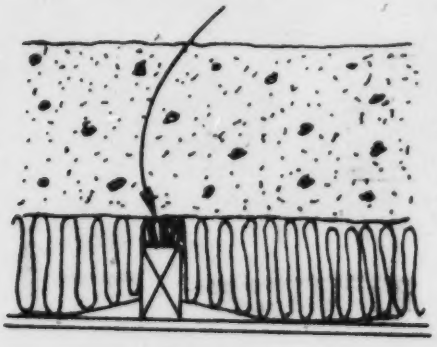
typical
clip
detail

10. Fill all small spaces.

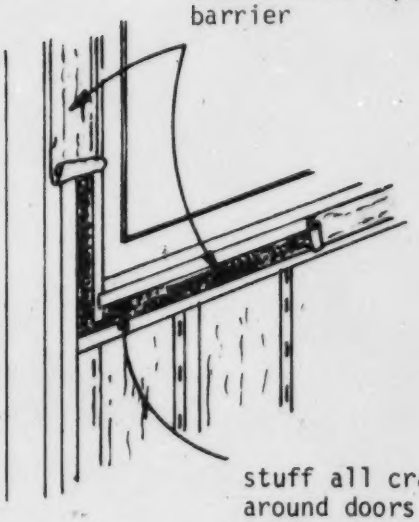



hand-packed insulation

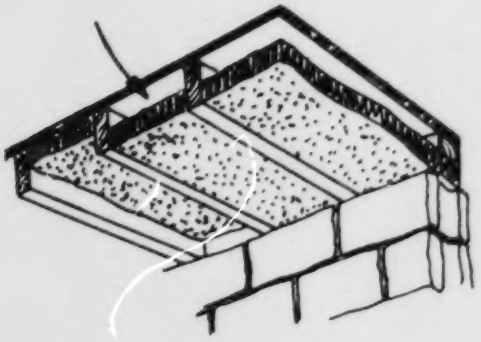


cover all insulated cracks with vapor barrier



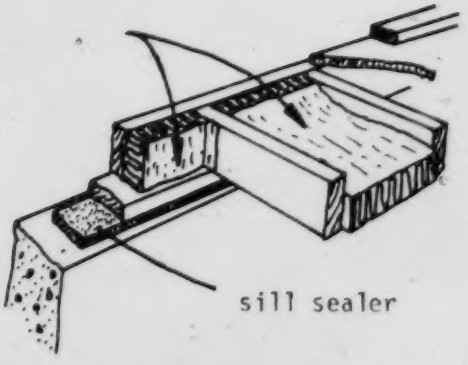
11. Place vapor barrier up under floor areas.

vapor barrier up

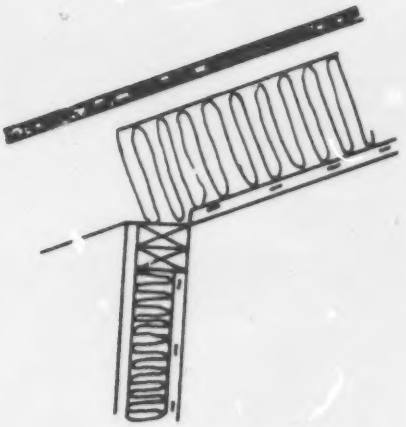


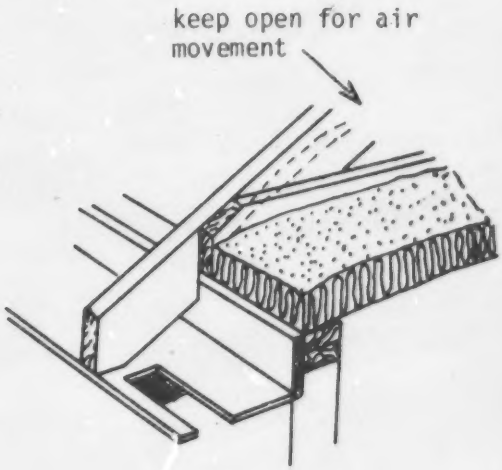
12. End of insulation blanket pushed up or short piece at header.

end of insulation
blanket pushed up, or
short piece at header

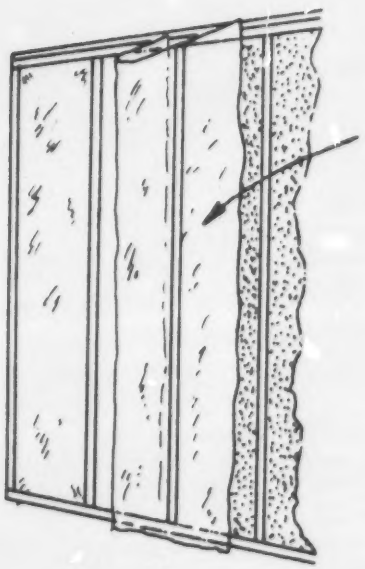


13. Place insulation over top wall plates in ceilings but allow for ventilation.






14. Form a continuous vapor barrier.



15. To insulate an attic floor where there is no insulation, lay batts between the joists. They do not need to be stapled. The vapor barrier must face down.

If some insulation already exists, add a layer of batts or blankets on top of the old. It is important that the new insulation not have an effective vapor barrier. Preferably, the new insulation should be unfaced - that is, nave been made without a vapor barrier. If unfaced material is not available, use the vapor-barrier type but remove the vapor barrier or slash it freely with a knife (then install the insulation with the slashed surface down).

16. DON'T insulate on top of recessed lighting fixtures, motors, and other heat-producing equipment that protrudes through the attic floor. To be in accord with the National Electrical Code, improvise a way of holding insulation 3 inches away from the sides of the protrusion make a sheet-metal shield, possibly by cutting the ends off a tin can of suitable size.

DO paint interior walls as a substitute vapor barrier if you are having a contractor install blowing insulation. Use two coats of vapor-resistant paint and brush them in well. (Paints vary widely in the rate at which they allow water vapor to pass through. Ask a paint dealer about the "perm rating" - vapor permeability rating - of the paint he carries. A rating of 1 perm or less for primer and finish coat combined is considered good. If the dealer doesn't know about perm ratings, ask him to check with the manufacturer.)

DON'T cover eaves vents with insulation. With batts, just be careful about batt placement. With pouring insulation, either construct a baffle with boards or lay pieces of thick batts next to the vents; you'll keep the wind from disturbing the loose wool and you won't inadvertently cover the vents in the first place.

DO work from the outer edge of the attic space toward the center. You'll be able to do whatever cutting and fitting is necessary at the center of the attic rather than near the eaves, where there's little headroom.

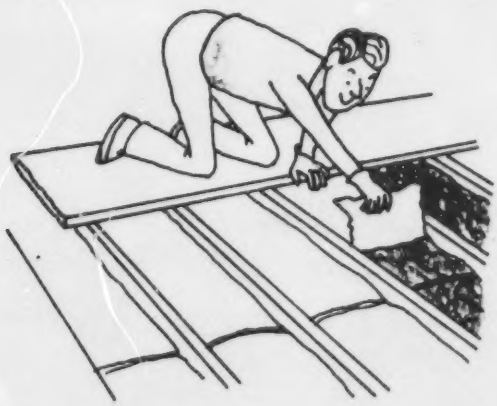
DO insulate the top of the attic scuttle panel. Staple directly through the edges of the insulation into the panel board.

DO hand-pack insulation around pipes and electricl cables that pass through the attic floor. Stuff openings around interior chimneys.

DO patch the vapor barrier of wall insulation if it has been torn. Strip a piece of vapor barrier from a scrap section of blanket or use polyethylene, taping the patch to secure it.

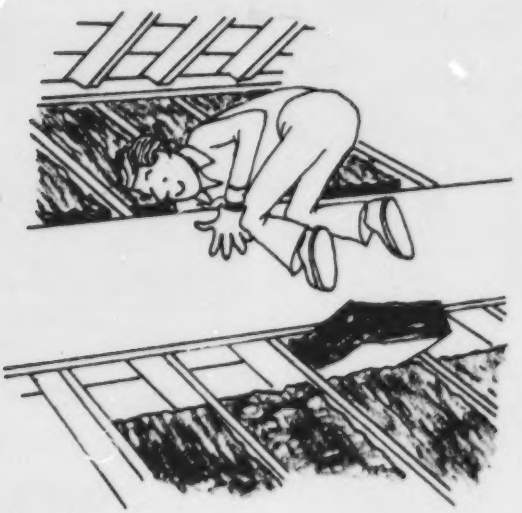
DON'T allow vapor barriers to be exposed. Cover them with gypsum board or some other non-combustible covering. Don't allow "breather" paper to be exposed, either. Breather paper is the covering around the non-vapor-barrier side (the side without flanges) of some batts. It's intended only to protect the insulation fibers during shipment and installation. Strip it off after the batts are in place.

DON'T allow gaps, or "fishmouths," at vapor barrier edges when you are insulating walls. Keep the edges tight against the studs.



DO put the vapor barrier side of insulation blankets and batts down in the ceiling - even if, when adding new insulation on top of old, you've slashed the barrier to let moisture vapor pass through.

DO insulate under attic walkways, pulling or pushing the insulation as needed. If much of the area is covered with flooring, you might need to remove some boards for access to the space.



## PERSONAL PRECAUTIONS IN INSTALLING INSULATION

Insulation fibers can cause skin irritation which could become a severe condition if proper protective measures are not followed. The general rule is: Do not allow contact of insulating materials to the eyes and respiratory system and minimize contact with the skin. This is possible by doing the following:

1. Wear protective clothing. Loose fitting long sleeve shirt-buttoned at the collar - gloves, long trousers, a cap, goggles and dust mask or a full-face mask.
2. Work in the morning or cool cloudy days. Avoid hot sunny days. Temperatures in the attic may exceed the safety limit for the body temperature. Also, the pores of the skin open as the body temperature rises and this allows fibers to become imbedded in the skin.
3. Shower with cold water after the work session. Cold water closes pores and washes off insulation.
4. Launder clothing before wearing them again.

Other safety measures include:

1. Do not smoke.
2. Utilize care around electrical wiring.
3. Avoid nails sticking through roof sheathing.
4. Lay planks across floor joists of attic to avoid breaking through ceilings.
5. Generally exercise personal safety precautions.

## SELECTION OF INSULATION CONTRACTORS

Many people would rather hire a contractor to install insulation. The reasons are many. General procedures for selecting a reliable contractor include:

1. Check the "yellow pages" of your phone book.
2. Consult friends and neighbors.
3. Ask a utility company.

4. When possible select at least three contractors for bids.

After narrowing down choices to three, check with the Better Business Bureau, ask the contractor for references, ask a bank for a credit rating on the contractor and check out the references and terms of the contract before hiring. Also, it is only fair that you give all contractors the same outline for the job. This is the only way to accurately compare estimates. Remember, too, deal only with contractors in terms of R-factor. It is not the amount of insulation you are concerned with.

Ask the contractor about insurance he carries to protect you, the consumer, against damage to the house.

Shop selectively, compare estimates, and inspect the completed job. These are key concepts in hiring an insulating contractor.

INSULATION

ASSIGNMENT SHEET #1

Home insulation check list

The following check list is for the student to use on his current living quarters.

| | | Yes | No |
|---|---|---|---|
| 1. | Does home have attic insulation? | ___ | ___ |
| 2. | Does home have wall insulation? | ___ | ___ |
| 3. | Does home have floor insulation? | ___ | ___ |
| 4. | Are furnace duct work pipes insulated? | ___ | ___ |
| 5. | Are hot and cold water pipes insulated? | ___ | ___ |
| 6. | Are crawl spaces insulated? | ___ | ___ |
| 7. | Does structure have storm windows? | ___ | ___ |
| 8. | Does structure have storm doors? | ___ | ___ |
| 9. | If structure has fireplace, does damper fit tightly? | ___ | ___ |
| 10. | If structure has basement, is it insulated? | ___ | ___ |
| 11. | Does roof have light colored shingles to reflect sun? | ___ | ___ |
| 12. | Does attic have ventilation facilities? | ___ | ___ |
| 13. | Does house have thermal windows? | ___ | ___ |
| 14. | Is caulking around doors sound? | ___ | ___ |
| 15. | Is caulking around windows sound? | ___ | ___ |
| 16. | Are exterior doors solid core? | ___ | ___ |
| 17. | Does thermostat of furnace or heating source automatically lower during sleeping hours? | ___ | ___ |
| 18. | Does structure have new cracks that are unsealed? | ___ | ___ |

INSULATION

ASSIGNMENT SHEET #2

Work sheet on insulation.

1. Contact local building supplier firm, county extension office or contractor. Obtain information concerning recommended standards based on "R"-value for location.

   ATTIC -

   FLOORS -

   WALLS -

2. What are the kinds of insulation recommended for the following areas?

   ATTIC (or ceiling) -

   FLOORS -

   WALLS -

3. Which are the ones that can be done by the home owner?

4. Which are the ones that can be done only by a contractor?

5. Secure prices for insulating in local areas.

   BATTS -

   BLANKETS -

   LOOSE-FILL -

   RIGID TYPE

INSULATION

ASSIGNMENT SHEET #3

Determining insulation needs of structure

1. Using graph paper on a scale of ¼"-1", prepare a diagram of floor plan of current personal housing.

2. Using information determined on Assignment Sheet #1, calculate the insulation needed to meet standards of "R"-factor for local area. State kind of insulation to be used for each area. Assume that it currently has no insulation.

   ATTIC -

   FLOORS -

   WALLS -

3. Compare actual insulation within the structure to ideal amount. What is you conclusion?

4. Calculate cost of insulation to provide sufficient "R"-factor needs of the local area.

INSULATION

TEST

I. True-False. Circle either "T" for true or "F" for false.

T F 1. Insulation is a successful means of saving energy.

T F 2. The heat loss in structures is usually greatest through the ceiling.

T F 3. Blowing wool insulation is usually installed by the home owner.

T F 4. The "R"-factor related to insulation will vary with respect to geographic location and climate.

T F 5. Some insulation is made by recycling scrap paper and newspaper.

T F 6. Fiber glass is frequently used in making insulation products.

T F 7. Cellulose insulation needs to be treated chemically for fire safety and vermin control.

T F 8. The vapor shield on insulation should be placed face down on walls to keep cold air out.

T F 9. The higher the U value of a wall the better.

T F 10. The insulation will increase comfort of a home.

T F 11. The garments that man wears have insulative value.

T F 12. Mineral wool is generally accepted as the most versatile form of insulation.

T F 13. Foam type insulation must be applied by contractors with special equipment.

T F 14. High "R"-factor indicates greater insulation capability.

T F 15. "R"-factor must be plainly marked on insulation bags to protect the consumer against faulty performance.

II. Match the terms to the proper identification by placing the correct response in the space provided.

_____16. Insulation made from scrap paper and newspaper.

_____17. Loose-fill insulation applied by pneumatic equipment

_____18. Sets guides and standards on "R"-factor.

_____19. Rolls of insulation, usually fiber glass.

_____20. Material providing resistance to flow of heat from one area to another

_____21. Insulation product made from inorganic glass, rock, or slag.

_____22. Loose-fill insulation meant to be poured into attic floor

_____23. Refers to resistance or effectiveness of insulation. High rating indicates higher efficiency

_____24. Preventative barrier that keeps cold air from outside and warm air from inside from coming into contact.

_____25. Insulation of foam type.

_____26. Indicates insulative characteristic and/or heat transference of materials. Low value means good structural insulation.

_____27. Expanded mica product sometimes mixed with styrofoam pellets used as insulation.

_____28. Strips of insulation purchased in 4" and 8" lengths.

_____29. Strips of insulation material of rigid quality, usually applied during construction.

_____30. Purpose of wearing long sleeves, safety goggles, etc., when applying insulation.

A. Mineral wool
B. Urea formaldehyde
C. Blankets
D. Pouring wool
E. Vapor barrier
F. Cellulose
G. ASHRAE
H. "R"-factor
I. Batts
J. Batt insulation
K. Safety
L. U value
M. Blowing wool
N. Vermiculite
O. Insulation boards

III. Different kinds of insulation require different methods of installation. Indicate who can best apply the following types of insulation by using "C" for contractor and "HO" for home owner.

_____31. Urea formaldehyde insulation.

_____32. Blowing wool insulation.

_____33. Cellulose insulation.

_____34. Mineral wool batts.

_____35. Mineral wool blankets.

_____36. Vermiculite insulation.

_____37. Pouring wool insulation

IV. List four factors that make installation of insulation a wise decision by the consumer.

38.

39.

40.

41.

V. Where to insulate is one of the decisions that the consumer must make. In the spaces below list five areas most frequently insulated.

42.

43.

44.

45.

46.

VI. What are three safety precautions that the individual should take when applying insulation?

47.

48.

49.

VII. Selecting a reliable contractor to apply insulation is a major consideration for the consumer. Describe how a consumer can determine reliability. Include at least four different factors to consider.

50.

51.

52.

53.

VIII. From the list below select four factors which are personal safety factors the individual should observe when installing insulation. Indicate by placing a check mark in correct space beside the statement.

_____Wear long sleeved shirts and long trousers.

_____Shower in hot water following installation.

_____Wear safety glasses, face masks, or goggles.

_____Install on hot dry summer day.

_____Wear gloves when installing insulation.

_____Cover recessed lights to avoid glare.

_____Wear cap.

_____Do not smoke.

INSULATION

TEST ANSWERS

I. True-False

1. T
2. T
3. F
4. T
5. T
6. T
7. T
8. F
9. F
10. T
11. T
12. T
13. T
14. T
15. T

II. Matching

16. F
17. M
18. G
19. C
20. J
21. A
22. D

23. H

24. E

25. B

26. L

27. N

28. J

29. O

30. K

III. 31. C

32. C

33. C

34. HO

35. HO

36. C

37. HO

IV. 38-41. Any four of the following:

(a) To keep heat inside in winter, reducing heat loss.

(b) To reduce heating bills in winter.

(c) To keep heat outside in summer.

(d) To reduce cooling bills in summer.

(e) To provide a more comfortable home.

(f) Conserve national energy supplies.

V. 42-46. Any five of the following:

(a) Attic - floorline, if not used; over head if used.

(b) Outer walls - adjoining unheated areas.

(c) Ceilings/dormer - heated rooms if no attic above.

(d) Floors - over unheated cellars and crawl spaces.

(e) Cellar walls - if basement is used for living space.

(f) Between "cellar beams".

(g) Between studs of "knee walls".

(h) Between joists of floor outside living space.

(i) Dormer walls.

(j) Dormer ceilings.

(k) Between sloping rafters.

VI. 47-49. Any three of the following:

(a) Choose day carefully.

(b) Utilize care around electrical wiring.

(c) Lay plank across floor joists of attic to avoid breaking through ceiling.

(d) Do not cover recessed lights - fire hazard.

(e) Avoid nails sticking through roof sheathing.

(f) Do not smoke.

(g) Exercise personal precautions above.

VII. Four different factors to consider in selecting a reliable contractor.

50. Ask utility company, friends, neighbors and check "yellow pages" of phone book.

51. Check with the Better Business Bureau and ask bank for report on contractor's rating. Ask for references. Check out references and completed contracts.

52. Get estimates and give all contractors exactly same outline for job. Utilize "R" - factor.

53. Check labels on bags of blowing wool for Federal government specifications. Count number of bags used. Ask contractor how he pays installers if hourly or by the square foot. Ask about insurance contractor carries.

VIII. 54. Any four of the following are personal safety factors.

(a) Wear long sleeved shirts and long trousers.

(b) Wear safety glasses, face mask, or goggles.

(c) Wear gloves when installing insulation.

(d) Wear caps.

(e) Do not smoke.